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Occupational Therapy with the Marine Program: Improving Self-Efficacy and Social Life Skills of Children with Neurodevelopmental Disorders

Satoru Gima[1,2], Naoko Matsuda[3], Kaori Ito[1,3], Shina Morikawa[1,3], Rie Naniwa-Kojyo[3], Atsuko Morikawa[1,3], and Hiromi Fujii[1,4]*

[1]Graduate School of Health Sciences, Yamagata Prefectural University of Health Sciences, Japan
[2]Ryukyu Rehabilitation Academy, Japan
[3]Division of Occupational Therapy, Kanon Co.,Ltd, Japan
[4]Department of Occupational Therapy, Yamagata Prefectural University of Health Sciences, Japan

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***Corresponding author:** Hiromi Fujii, Department of Occupational Therapy, Graduate School of Health Sciences, Yamagata Prefectural University of Health Sciences, 260 Kamiyanagi, Yamagata, 990-2212, Japan, Tel: +81 (23) 686-6649; Fax: +81 (23) 686-6649; Email: hfujii@yachts.ac.jp

Abstract

The Marine Program, which takes advantage of nature in Okinawa, was offered to children with neurodevelopmental disorders (NDDs). This study examined the effectiveness of the regularly scheduled Marine Program by focusing on the perceptions of parents based on their involvement with children with NDDs. The subjects and methods included footprints from the records of three cases, results of questionnaires filled by parents of 27 children (All boys), and text mining of interview data from nine parents. The parents perceived that the Marine Program was most effective in improving the physical aspects of the children followed by communication and behavior. Out of the 33 words in the text mining co-occurrence network, the sub-network indicated by eighth words centered on *himself* and *staff* suggested the role of the program in sublimating the accumulated frustration of the participants. Moreover, the sub-network of seven words from *himself* to *empathy* and *speaking* via *feeling* is inferred to represent the social life skills that the parents perceived in their children. These findings suggested that Marine Program improved the self-efficacy and social life skills of the participants.

Keywords: Autism Spectrum Disorders; Attention Deficit/Hyperactivity Disorder; Communication; Text Mining of Interview; Co-Occurrence Network Analysis

Introduction

The Japanese archipelago consists of 6,852 islands, including Honshu, Hokkaido, Kyushu, Shikoku, and Okinawa Island [1]. Okinawa Prefecture, where the authors' developmental support projects are located, consists of the Nansei Islands (Okinawa, Sakishima, and Daito), which is a group of 160 islands scattered between the East China Sea and the Pacific Ocean. The coast of Okinawa is a beautiful emerald green sea with high clarity and is home to a diverse array of marine flora and fauna. The west coast of central and northern Okinawa and the islands of the Kerama Archipelago belong to the Okinawa Coastal National Park, where coral reefs comprise the base for swimming and various other

marine sports [2]. Okinawa Island has a subtropical, warm, and humid climate with annual precipitation of more than 2,000 mm and an average annual temperature of 23.1 °C. On extremely hot days, however, the maximum temperature rarely exceeds 35 °C. The sea temperature almost never drops below 20 °C throughout the year, whereas the sea opens in March or April, and swimming is possible until October.

In 2010, the natural rate of increase in Okinawa Prefecture was 5.0 persons per 1,000 population, which is the highest among all prefectures. The total fertility rate in Okinawa Prefecture in 2018 was 1.89, which is higher than the national rate of 1.42 [3] and the highest in Japan since 1975 [4]. The reasons for the high birth rate are as follows: (1) the locals uphold the communal spirit and can manage to raise their children and (2) childbearing is not restricted until a boy is born, resulting in a high fertility rate due to the importance of male descent [5]. The percentage of young women aged 20+ years who are married, which is a high fertility/marital status rate," is higher than the national average [6]. Meanwhile, the number of students attending "special support classes for autism and emotional disabilities" in public elementary and junior high schools reached 3,389 in 2019, which is a sharp increase of 12.5 times across 10 years from 272 in 2010. The national average also increased by a factor of 2.4. However, Okinawa stands out [7].

Autism spectrum disorders (ASD) are developmental with two main symptoms: "impairments in social communication and social interaction" and "limited or repetitive behaviors, interests, and activities" [8,9]. Social impairment is a qualitative impairment in the way we interact with others. For example, Child with ASD lack interest in peers, experience difficulties in playing pretend and exhibiting social responses; and are unable to make eye contact, gesture, understand, or share emotions. Behaviors and interests exhibit a limited, repetitive, and stereotypical interest and activity style. For example, repeated hand flapping, stubborn resistance to changes in behavior patterns, and insistence on eating the same food or wearing the same clothes every day. They are hypersensitive to sound, smell, and the touch of clothing and may be reluctant to be touched. Alternatively, their senses are dull in several areas, such that they may not be bothered by dirt. Children with ASD frequently display these characteristics from an early age and experience difficulties in social life.

The incidence of ASD in Japan is 2.2 times higher in boys than in girls with a prevalence 3.22%, whereas the cumulative incidence of ASD by 5 years old is 1.31% (95% CI 1.00–1.62) [11]. However, previous studies reported that only 11.5% of children have ASD alone, whereas the remaining 88.5% have at least one co-existing neurodevelopmental disorder (NDD) [11].

Attention deficit/hyperactivity disorder (ADHD) is defined as a persistent, negative impact on life and schoolwork for more than 6 months due to problems, such as inattention, restlessness, and impulsivity, which are inappropriate for age or development [10,12,13]. Thus, the current study examined the effectiveness of a regular Marine Program based on our involvement with children with ASD over a period of approximately seven years. Although a result of bias in the development and maturation of brain functions, the cause of ASD remains unknown. Symptoms are inferred to be caused by a complex combination of genetic predisposition, perinatal problems, and environmental factors. Approximately 5% of children are diagnosed with ADHD, whereas boys are three to five times more likely than girls to be diagnosed with ADHD [12,13].

The authors have been providing the Marine Program that features nature in Okinawa to improve self-efficacy and social life skills for children with ASD and ADHD. They offer two types of programs, namely, regular and camping. The main contents of the Marine Program are swimming, snorkeling, stand-up paddleboard (SUP), fishing, mangrove canoeing, coastal exploration, bonfires, and barbecue parties. Previously, we reported on the camp-type Marine Program that lasted for four days and three nights at Zamami Island [14]. This study examined the effectiveness of the regularly held Marine Program focusing on parents' interaction with their children with NDDs.

Subjects and Methods

The subjects of this report were children and their parents who were participating as of our regular Marine Program in the end of March 2021.

Participants and Method 1

The subjects were three children under the Marine Program in March 2021. The children and their parents provided consent for the study. Data were based on the records of the three participants and classified into three or four periods of change in the participants. Case A was 17 years and 0 months old (boy); Case B was 15 years and 0 months old (boy); and Case C was 13 years and 6 months old (boy).

Participants and Method 2

The questionnaire was distributed to 32 (82.1%) out of the 39 parents of children who agreed to participate in the Marine Program. Out of the 32, only 27 (84.4%) responses were received and included as data. Table 1 presents the questionnaire.

Please read the following questions and mark or fill in the appropriate answers

Date of Entry: _____

1. Do you feel that your child has changed as a result of the Marine Program? Please select the answer that applies to you.

□ YES
□ NO

2. In which of the following aspects do you feel that your child has changed? Multiple answers are possible. If you have more than one answer, please prioritize them as 1, 2, 3, and so on.

( ) Physical aspects (e.g., better posture due to improved core strength)
( ) Mental aspects (e.g., became kinder; less angry)
( ) Life aspects (e.g., started helping out)
( ) Activity aspects (e.g., expanded range of play)
( ) Behavioral aspects (e.g., more able to predict danger; less impulsive)
( ) Interpersonal (e.g., more cooperation with friends and family; more attention to detail)
( ) Communication aspects (e.g., more words; more communication of feelings)
( ) Self-affirmation aspects (e.g., increased self-confidence)
( ) Motivation (e.g., more willingness to try without giving up)
( ) School (e.g., started to go to school; started to get involved with friends at school)
( ) Other （ ）

3. Why did you choose the item(s) in Question 2? What are specific episodes in which you felt a change in your child? Please mark the items you selected in Question 2 and describe the contents (reasons and episodes) in the free text on the next space. If you have more than one, please describe the contents of each.

□ Physical aspects
□ Mental aspects
□ Life aspects
□ Activity aspects
□ Behavioral aspects
□ Interpersonal
□ Communication aspects
□ Self-affirmation
□ Motivation
□ School
□ Other （ ）

＊Free-entry column

4. Which of the following items do you expect from the Marine Program? Multiple answers are possible. If you have more than one answer, please prioritize them as 1, 2, 3…

( ) Physical aspects (e.g., better posture due to improved core strength)
( ) Mental aspects (e.g., became kinder; less angry)
( ) Life aspects (e.g., started helping out)
( ) Activity aspects (e.g., expanded range of play)
( ) Behavioral aspects (e.g., more able to predict danger; less impulsive)
( ) Interpersonal (e.g., more cooperation with friends and family; more attention to detail)
( ) Communication aspects (e.g., more words; more communication of feelings)
( ) Self-affirmation aspects (e.g., increased self-confidence)
( ) Motivation (e.g., more willingness to try without giving up)
( ) School (e.g., started to go to school; started to get involved with friends at school)
( ) Other （ ）

5. Which of the following items do you expect from the Marine Program? Multiple answers are possible. If you have more than one answer, please prioritize them as 1, 2, 3…
（ ）Physical aspects (e.g., better posture due to improved core strength)
（ ）Mental aspects (e.g., became kinder; less angry)
（ ）Life aspects (e.g., started helping out)
（ ）Activity aspects (e.g., expanded range of play)
（ ）Behavioral aspects (e.g., more able to predict danger; less impulsive)
（ ）Interpersonal (e.g., more cooperation with friends and family; more attention to detail)
（ ）Communication aspects (e.g., more words; more communication of feelings)
（ ）Self-affirmation aspects (e.g., increased self-confidence)
（ ）Motivation (e.g., more willingness to try without giving up)
（ ）School (e.g., started to go to school; started to get involved with friends at school)
（ ）Other （ ）
＊Free-entry column

Table 1: Original Questionnaire.

Participants and Method 3

The method used was a 60-minute semi-structured interview with nine parents of children who participated in the Marine Program.

The interview guide posed the following questions:

- Do you feel that your child has changed in any way through the Marine Program?
- What aspects of your child's life have changed?
- How have the changes affected your child's living situation?
- Can you tell us about specific episodes that have affected your living situation?
- What do you expect from the Marine Program?

The contents were recorded using a voice recorder.

Participant	Age		Diagnosis	Sex	Participation Status		
	Year	Month			n	Year	Month
A	10	6	ADHD	M	15		11
B	8	7	ASD; ADHD	M	5		5
C	11	9	ASD; ADHD	M	17		8
D	12	9	ASD	M	14		11
E	10	1	ADHD	M	11	3	11
F	9	10	ADHD	M	7		5
G	7	9	ASD	M	6		5
H	10	11	ASD	M	29	1	4
I	5	8	ASD (PDD)	M	16	1	8
J	8	2	ASD (PDD)	M	20	1	5
K	13	3	ASD	M	28	1	5
L	7	8	ASD	M	16	3	3
M	6	10	ASD	M	19	1	5
N	10	9	ASD	M	45	3	10
O	16	6	ASD (PDD)	M	37	2	3
P	15	0	ASD	M	56	3	8
Q	13	7	ASD	M	32	2	11
R	11	7	ADHD	M	39	2	11
S	15	7	ASD	M	51	4	7

T	10	8	ASD (PDD)	M	47	5	0
U	13	5	ASD	M	28	6	9
V	13	9	ASD (PDD)	M	33	6	7
W	17	0	ASD; ADHD	M	31	6	11
X	12	4	ADHD	M	22	6	10
Y	16	9	ASD	M	29	6	2
Z	13	6	ASD	M	24	6	10
aa	12	0	ASD	M	60	5	10

Table 2: Profile of participants in the Marine Program.
ADHD: Attention deficit hyperactivity disorder
ASD: Autism spectrum disorders
PDD: Pervasive developmental disorders
n: Number of times participating in the Marine Program

Ethical Considerations

The participants and their parents read and understood the instructions for the study and participated voluntarily. The criteria for participation were that the child had no cognitive or skeletal muscle problems. The Ethics Committee of the Canon Co. granted the ethical approval for this study (date of approval: July 12, 2021; approval number: E-003).

Recording equipment

The study used a voice recorder (SR502J iFLYTEK JAPAN AI SOLUTIONS Co., Ltd., Tokyo) to record the interviews.

Analysis

KH Coder 3 was used for analysis [15]. The interview data in text format were subjected to morphological analysis to extract words and compound words. In addition, pronouns were changed to nouns based on the meanings of preceding and subsequent sentences. For example, self was converted into himself and so on. The converted pronouns were person and self.

A list of extracted words was then created, and the relationships between words were analyzed by co-occurrence network analysis. The notation used was co-occurrence when two or more words were used in one sentence, whereas association when used in the preceding and subsequent sentences.

Effectiveness		Number	Examples of descriptions of parents	Scores
YES		23		
	Physical aspects	13	The child's posture improved, and the way he walks and runs improved. Child is less likely to be warned about their posture during class.	56
	Mental aspects	8	The child began to express feelings of anxiety and anger with words. My child is no longer afraid of water and has a positive attitude to take on various challenges.	33
	Life aspects	4	The child became able to listen to others and be punctual. The child was able to change clothes by himself. When my child forgot to bring a plastic bag, he started to wrap his wet swimsuit in a bath towel and put it in the bag.	17
	Activity aspects	13	My child devised his own play and increased his play. The experience of the Marine Program had increased my child's capabilities and broadened his activities.	38
	Behavioral aspects	10	The child is now able to predict dangers in the ocean (nature) and can go to the beach with more confidence than before. The child used to run out into the street and jump off suddenly, but through the Marine Program, he has become more cautious.	41
	Interpersonal	8	The child was constantly running away from his homeroom teacher and the staff, but he has improved. The child became fond of playing with his friends. My child used to have a lot of trouble with the kids in his class, but now he has less trouble.	20

	Communication aspects	10	My child is now able to express his thoughts and opinions well in conversations with older brothers and sisters who are close to his age. He often cried and flailed because he could not communicate his feelings well verbally. However, he has grown to love fish and sea creatures and enjoys talking with the staff.	47
	Self-efficacy	8	Being in contact with the sea (nature) has become a time of healing, an extraordinary time away from the urban life. They became confident in their ability to ride Stand-up Paddleboard [SUP] and canoes and began to boast about it.	37
	Motivation	9	My child has been reluctant to wear wetsuits, shoes, etc., but he has solved the problem in his own way and is now ready to wear them on his own. He had been reluctant to go to school, but now there are days when he looks forward to the Marine Program and can do his best at school, which motivates him.	30
	School	5	My child had been truant, but he is now able to attend school. My child was unable to attend school for eight months, but now he can. My child is involved in club activities and has a good career plan.	17
	Other	3	My child used to be afraid of the ocean until he started the Marine Program, but now he likes the ocean (water) and seems to enjoy it. Although my child is very clear about where he doesn't want to go, he is very excited about the Marine Program.	10
NO		2	The child also did the Marine Program in private and did not feel any change. I don't see my child as having changed with the Marine Program.	

Table 3: Changes and items perceived by parents.

Expectation	Number	Examples of descriptions of parents	Scores
Physical aspects	16	My child is not very athletic, so I want him to work out. He is often pointed out as having a weak core, so I am hoping he will, especially since he has shown interest in SUP.	46
Mental aspects	14	He seems to be reluctant (embarrassed) before the Marine Program, I would like to see him improve little by little. I hope that he will continue to learn to control himself and solve his problems and anxieties and go on with his happy and joyful life.	43
Life aspects	7	There are a lot of things to prepare for the Marine Program, so I want the child to be able to manage their belongings by themselves (and I want them to forget fewer things).	34
Activity aspects	6	All he does is play games at home. I want my child to find something else to do besides playing games.	22
Behavioral aspects	11	I hope that my child can learn to deal with his feelings, because he is still influenced by them and can be violent at times. My child is cautiously engaged during the Marine Program, and I want him to continue to be able to anticipate danger.	33
Interpersonal	13	My child's relationships, communication, and interactions with others will last a lifetime, so I want him to be able to do it well. I want my child to be able to understand the feelings of others.	40
Communication aspects	18	I think my child is good at observing what's going on around him, so I want him to be able to communicate smoothly by putting into words what he feels at the time. My child is not very good at expressing his feelings, so I want him to gradually draw them out through his favorite activities. I hope my child can learn how to communicate with his friends.	41
Self-efficacy	12	My child still feels intimidated by unfamiliar places and people, so I hope he can gain confidence through the Marine Program. I want my child to have a competitive spirit through SUP.	31

Motivation	13	My child sometimes loses motivation when he is losing a game, and I hope he can keep going until the end without giving up. I want my child to be more motivated. He is often indifferent.	36
School	3	My child says he will study, but he is a procrastinator.	16
Other	0		0

Table 4: Changes and items expected by parents.

Results

Case A: 17 Years and 0 Months Old (boy)

Case A had a diagnosis of ASD and ADHD. He joined the Marine Program every Saturday from 5:00 PM to 6:00 PM and every second and fourth Sundays of the month at 9:00 AM in April 2014. He was 10 years old and in fifth grade at the time. He didn't go to school much but had a good relationship with a homeroom teacher. He attended school two to three times per week (only in the morning). He lacked interest in SUP but enjoyed other activities, such as catching fish using nets or bare hands and diving off rocks. He preferred to do activities alone. The occupational therapist [OTR] provided SUP as an activity with the staff. As a result, Case A established a relationship with the staff. However, the child's relationship with the staff was constrained, such that an interpersonal relationship was limited.

In 6th grade, his homeroom teacher was replaced. He was unable to build a trusting relationship with the new homeroom teacher and completely stopped attending school in November 2015 (age 11, 6th grade). At the same time, he experienced an important encounter with a person committed to SUP. He looked up to that person as his SUP master. Case A then became engaged in SUP with the objective of winning places in competitions. However, he never attended school and graduated from elementary school. During junior high school, he exerted effort to go to school. However, he kept going back and forth between the classroom and the common room. In the fall of his first year, he participated in a SUP competition and won third place, which increased his engagement in SUP. Alternatively, in the classroom, his homeroom teacher frequently warned him and clashed with him, such that he gradually stopped attending school.

In our discussion, he said, "I want to go if it's a Marine Program." Thus, we picked him up and dropped him off every day and provided him with training in SUP and social skills. In the program, we requested him to describe unpleasant experiences in the classroom to determine their cause. He relayed that his sensory characteristics were affected and that he was unable to capture the teacher's intentions properly. Therefore, the program was designed to incorporate his strengths and weaknesses. After approximately two months in the program, he was able to re-enter the special classroom at his middle school.

As an eighth grader, he participated in the team competition of an SUP tournament. His team won and beat a professional team. Although this competition expanded his interpersonal relationships, it also highlighted his immature communication skills. However, he was able to respond to praises from the opposing team with a baton. After this experience, he said, "Now that I know how to live my life, I'm okay." Since then, he went to the special class every day and participated in the Marine Program less frequently. Before graduating from junior high school, he said, "I want my mother and the staff of the Marine Program to witness my graduation ceremony." He went back to his original classroom and graduated from junior high school.

Later, he joined a camp-based Marine Program and worked with other participants. This experience helped him became more considerate of other children and able to anticipate dangers and assist the staff. Moreover, provided appropriate advice to other children during SUPing. He is doing well in high school and is planning to enter a technical college.

Case B: 15 Years and 0 Months Old (boy)

Case B was diagnosed with Asperger's syndrome at the age of five. Since from he entered the regular class of a public elementary school, he tended to make strange noises during class, liked to jump rope, was unable to sit still, and to play with spit on the desk. The children bullied him by calling him stinky, dirty, and disgusting. He complained of frequent headaches around May of his fifth year in elementary school. A visit to a neurosurgeon led to a diagnosis of tension-type headache. At the time, he stopped attending school and started to use our developmental support program. Case B was mainly involved in indoor activities. During the summer vacation of his sixth grade in elementary school, he was introduced to the Marine Program. He was unable to participate in group activities in the Marine Program. Moreover, he prepared and changed his clothes in a separate place from other children; when he moved to the sea, he did so with the staff and at a different time from other children.

During his first year in junior high school (public school, regular class), he resumed attending school and restarted his school life. However, he became mentally unstable and said that he was worried about other people looking at him and that my voice sounded strange (low). His tension headache recurred, such that he stopped attending school again. He was promoted to second grade in junior high school but did not attend. When he moved on to third grade, he began to ask the staff for advice about his future in between the Marine Program. He and the staff began to investigate high school brochures. At the time, he and the staff set a goal to achieve within the Marine Program. Goal 1: He will exercise in the same space, although he is separated from other participants. Goal 2: He will prepare, clean up, and move with the participants. Goal 3: The staff will intervene and play with him and the other participants. Goal 4: He will help other children in need to prepare, and he will talk to them.

Initially, he was unable to move spontaneously. However, with guidance and encouragement from the staff, he eventually accomplished goals 1 and 2. By summer, he achieved the four goals and was able to do the exercises before the program within the same vicinity as the other children. For goal 3, they invited other children in a game of tag using SUP. The children played tag several times after this incident. During summer vacation, they played tag, tag-team game, beach volleyball, and water polo, and gradually developed from single-player games to those that required teamwork and achieved their goal.

He gained confidence from the said events and expressed his intention to the staff that he will go to a high school with a twice-weekly schedule in the fall. Therefore, the staff held a monitoring meeting with his mother and a support counselor to establish an environment that will render studying easy for him. He took an online tutoring course, gradually caught up on his studies, and successfully enrolled in high school in the spring. In the beginning, he was anxious about high school life, but he attended all the schooling sessions and participated in events such as the freshman social gathering. At the same time, he gradually made friends with the same hobby (video games) as him, and by June, he was able to play with them at home. His high school life is very full, he attends school without missing a day, and his use of our developmental support center and marine program has been reduced to three times a month. From time to time, he would contact us and say that he was going out with his friends and needed a break.

Case C: 13 Years and 6 Months Old (boy)

Case C was diagnosed with ASD. He was in the first grade of elementary school (at that time, a support class in a public elementary school) when his homeroom teacher told him that he could not handle his panic. He then began to use our developmental support center. His therapy consisted of indoor play based on sensory integration theory and our marine program. The marine program included walks on the beach, SUP, and spontaneous play. The vice principal was involved on a one-on-one basis until the end of his second year, and his mother accompanied him to and from school and classes until his third year. In the marine program, he gradually became more balanced on both sides and was able to ride a SUP. At the same time, he started to like swimming and jumping off the rocks.

When he was in the third grade, his homeroom teacher suggested that his mother transfer him to a special needs school. Although he expressed that he did not want to go, the family began to prepare for the transfer to the special needs school with some concern. He was transferred to a special needs school in the fourth grade. At that time, he frequently had epileptic seizures at home and at school and would act out in panic. He cried and pleaded with his mother, “I want to go back to my old school.” Under these circumstances, his pleasure was to participate in the marine program every Saturday. According to his mother, “He went to school with the goal of participating in the marine program.” The marine program did not cause him to panic or have epileptic seizures. However, his daily frustrations were accumulating, and he sought strong sensory stimulation. And more often than before, he wanted to jump from the rocks. This situation continued for about a year. In the fifth grade, he became accustomed to the environment of the special needs school to which he had been transferred and settled down. In the sixth grade, he became satisfied that school was fun and graduated from elementary school by participating in school trips and sports events.

When he moved to a special needs middle school, he was not used to wearing a uniform and could not put on a belt. He also forgot to zipper up his pants and the change in environment caused seizures and mental fatigue. Nevertheless, he continued to go to school, looking and looked forward to the Marine Program on weekends. He became interested in fish, which is a new interest. His goal was to fish and catch fish using a net. In the Marine Program, he shared fishing rods with other participants, and his friendships expanded through fishing. Furthermore, he told the staff that he wanted to eat the fish he caught with his family. He had tactile sensitivity and refrained from touching fish. However, he learned to handle them with the help of the staff.

In his second year in junior high school, he gradually settled down and lead a stable school life. He was unable to walk barefoot on grass or soil because of his sensitivity to touch. However, he could walk barefoot on grass in his yard. In

addition, he no longer panics when his schedule changes and is able to transition smoothly. He understood the importance and sadness of life and created a poem called "Tamang's Feelings," which won a prize at the 18th God's Baton Award (sponsored by a Japanese newspaper called Ryukyu Shimpo). The judges gave high marks and commented that it was equivalent to the highest award. With the hope of becoming a fisherman in the future, he is continuing his fulfilling school life and participation in the Marine Program.

Questionnaire

Table 3 depicts the changes in the children and the items that the parents perceived. Out of 27 parents, 25 recognized the changes in their children. The most common changes were related to physical and activity areas with 13 parents reporting these changes. The results of weighting indicated that the top three items in the following order were physical, communication, and behavior.

The two parents who responded with, "I did not feel any change," gave one reasons: "My child uses the service once or twice a month, so I do not feel any change" and "My child is selfish at home, so I don't know much about him. I would like to know what kind of therapy and education the Marine Program provides to my child, and when that therapy and education is applied in his daily life." In terms of their expectations from the Marine Program, 18, 16, and 14 respondents were interested in communication, physical aspects, and mental aspects, respectively. The results of the weighting demonstrated that the top three items in the following order were mental, physical, and communication.

Semi-Structured Interview

Five, three, and one of the nine parents were aged 30s, 40s, and 50, respectively. Moreover, five were housewives, whereas four were employed. All of them graduated from high school.

The total number of words obtained from the semi-structured interviews was 5,115. After the co-occurrence network analysis of these words, they were classified into four types of networks.

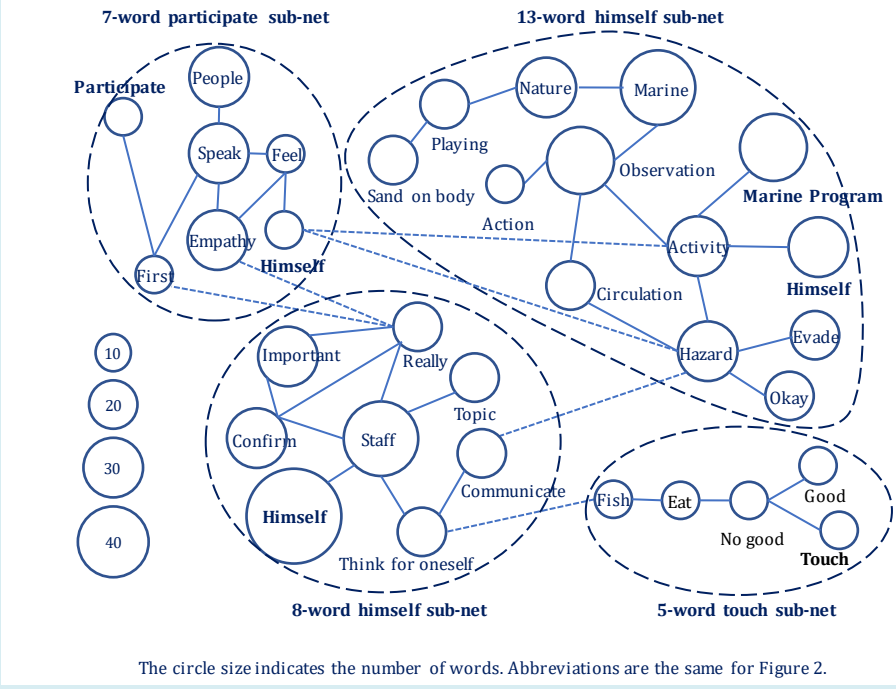

Figure 1: Co-occurrence networks with 33 words.

Figure 1 depicts the co-occurrence network of 33 words, which consisted of four sub-networks, namely, "13-word himself sub-net," "8-word himself sub-net," "7-word participate sub-net," and "5-word touch sub-net." A few example of the interviews that served as the basis for this co-occurrence network is as follows:

When he started going to the Marine Program, he became more proactive and started working with others and asking questions of the teacher before taking action. He now

understands the importance of a collective and supportive role and is better able to prepare himself.

Before, he was not very interested in interacting with adults (including friends) and spent a lot of time locked in his own world. Now that he continues to participate in his favorite Marine Program, I can see that he enjoys spending time with the staff and his spontaneous comments are appropriate for the occasion."

As a result of the synergistic effect of continuing to like the marine activities (SUP), he is now more motivated to do the riding he have been doing for a long time, and he is actively setting goals and thinking about the exercises he needs to do now.

He is gradually able to express his anger in words.

Since the start of the Marine Program, my child has become more self-aware and able to recognize danger.

My child is getting a lot of praise and he has become very confident in himself. He said, "I'm okay. I'm doing better than before," he said.

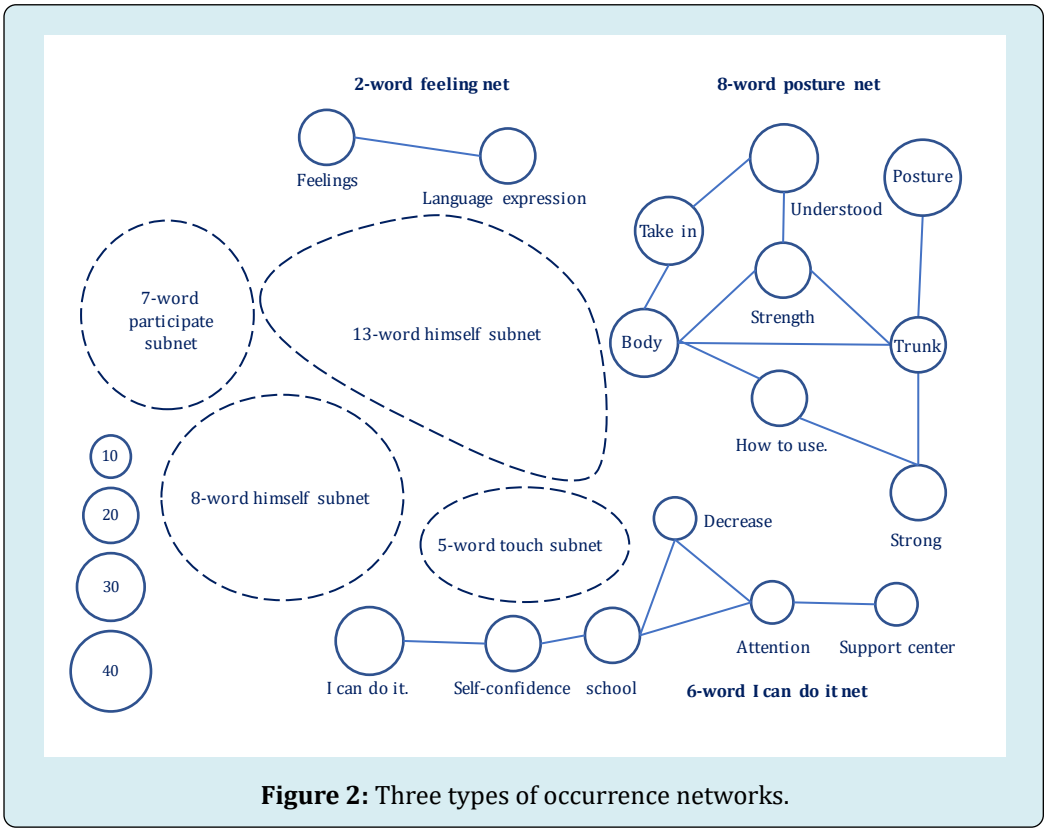

Figure 2: Three types of occurrence networks.

Figure 2 illustrates the three types of co-occurrence networks, namely, "8-word posture net," "6-word I can do it net," and "2-word feeling net."

Excerpts of the interview that led to this co-occurrence network are as follows:

- With the SUPs and boats and stuff on the water, he got to know how to put his body force and posture and where to put the center of his torso. He used to get a lot of attention in school because of his bad posture. Through the Marine Program, his core has been strengthened and his posture is better, and he gets less attention.
- My son's confidence in his ability to do things has become much stronger.
- My son is now able to communicate his feelings in his own words.

Discussion

The characteristics of ASD (and Asperger's syndrome) are as follows.

(1) speaking without reading the atmosphere (as a result, they are ostracized); (2) having difficulty in eye contact and lacking in facial expression; (3) panicking and becoming unable to think during unexpected events; (4) insisting on their ways and rules; (5) sensory sensitivity or insensitivity; (6) clumsiness with hands; (7) being preoccupied with details and unable to complete tasks; (8) easily irritated by re-experiencing unpleasant scenes [8,9]. In addition, the abovementioned symptoms can lead to depression and other

mental illnesses secondary to the inability to communicate well with others or to perform well in school or work [16,17].

Alternatively, inattention, which is a characteristic of ADHD, includes (1) many inadvertent mistakes during school and work; (2) inability to maintain attention during tasks and play activities; (3) the appearance of listening when directly spoken to; (4) not following directions and completing tasks; (5) having difficulty in sequencing tasks and activities; (6)avoiding tasks that require sustained mental effort, (7) being easily distracted by other stimuli; (8) experiencing forgetfulness in daily activities. Hyperactivity/impulsivity includes (1) fidgeting with arms and legs or wriggling in chair; (2) leaving seat during class; (3) running around or climbing high places in inappropriate situations; (4) being unable to play quietly; (5) acting as if driven by an engine; (6) talking too much; (7) responding to questions before they are finished; (8) not waiting their turn; and (9) interrupting others [12,13].

Case Studies A, B, and C demonstrate that the children participating in the Marine Program possessed many of the abovementioned multiple characteristics, which renders getting along in groups in the classroom difficult for them. Therefore, the study infers that they experience lower levels of self-efficacy compared with children with typical development. Self-efficacy denotes an individual's judgment of his or her capabilities to organize and execute courses of action [18,19]. In other words, self-efficacy is the feeling that "I am capable of doing it" [20]. Moreover, it pertains to one's trust in one's abilities. When Case A first joined the Marine Program, he exuded a sense of powerlessness and was unable to exercise self-efficacy. In addition, his experience with his homeroom teacher in sixth grade led him to a negative spiral of helplessness and withdrawal at home. Hence, the staff of the Marine Program needed to increase his self-efficacy. He needed to develop a sense of "I don't know what the outcome will be, but I'm going to try anyway." Case A had an expectation about efficacy when he met the mentor who led him to SUP. In this manner, he was able to say, "I could hold on to my SUP and go into the water!"; "I could get on a SUP!"; "I could stand on the SUP!"; and "I can paddle it!" These findings suggest that his self-efficacy through SUP led to a positive spiral of increased motivation, execution of the activity, positive outcomes, self-efficacy, and motivation.

Case B joined the Marine Program through truancy due to bullying. He had an extremely low level of self-efficacy and was afraid to interact with others. Therefore, his interpersonal contact with the staff remained limited. However, he became able to talk to the staff about his career path when he was promoted to third grade in junior high school due to this relationship. The Marine Program became a place where he could feel at home and was able to face the future with the help of the staff that he could trust.

Although Case C was sensitive to environmental changes and repeatedly panicked, he found a place to vent his frustrations, that is, enjoying in the Marine Program. He learned the process of making friends through the Marine Program and applied them to his school life. Through fishing, he understood the importance and sadness of life, which enabled him to view himself objectively.

A wall-known fact is that the positive spiral demonstrated by the three case studies is important for the self-efficacy and social life skills of children with ASD and ADHD characteristics. However, providing small steps appropriate to the individual children is difficult. This step requires an understanding of the four sources of self-efficacy formation in children, namely, (1) achievement experiences, (2) agency experiences, (3) verbal persuasion, and (4) physiological and emotional uplift. Case A accumulated achievement experiences through SUP, where his vicarious experience began with a pseudo-experience by watching and listening to the experiences of his SUP master. The verbal persuasion was the positive words "You can do it" from the people around him involved in the Marine Program. The cases themselves were then able to perceive physiological and emotional arousal by getting in shape and boosting their mood. Furthermore, praises from the rival team, when Case A won the SUP competition, enhanced his self-esteem [21,22]. Moreover, the study infers that Case A acquired skills necessary for socialization, such as communication and interpersonal skills, due to increased self-efficacy through the SUP experience. These findings suggest that the manner in which the staff interacted with each case increased their self-efficacy and led to the improvement of their social life skills.

Conversely, when the parents were asked to give multiple answers on the aspects of their children that improved, "physical" was the most common, and the priority of the item was also high. The Marine Program involves several activities on the beach and in the water, it leads to the strengthening of entire body muscle strength and cardiopulmonary function, including the muscle groups in the lower limb. This fact also applies to children with ASD and ADHD characteristics [23,24]. The parents stated that their child's "posture has improved," "sitting style has improved," "walking and running style has improved," and "I (the parents) feel that my child's body" is being trained. The physical aspect also accounted for the highest percentage of the changes expected by the parents. The parents of the children focused on their child's posture and muscle strength, because children with ASD frequently exhibit a mild neurological dysfunction, which pertains to a dysfunction in posture and muscle tone, impaired fine motor control, impaired coordination, excessive association

movements, and movement disorders [25–28]. Therefore, ASD in children may lead to secondary movement disorders due to truancy or withdrawal from school. The parents' questionnaires were expected to help them understand their children's characteristics and improve their physical aspects." In the co-occurrence network by text mining, the "8-word posture net" was found to bear words related to the development of body functions.

The next items in the order of priority were communication and behavior. Free comments were as follows:

- My child has become more verbal and able to express his feelings through contact with older friends and staff.
- My child has started to participate in the Marine Program and is able to communicate better."
- My child used to run away from his homeroom teacher and staff, but this has improved."
- My child is now able to predict the dangers of the ocean (nature), and I feel safer going to the beach than before.

Improvement in the communication and behavioral aspects is important to social life skills. The participants aimed to acquire social life skills, such as "being able to greet people," "being able to hold a good conversation," "being considerate of others," "being able to follow activities better," and "being able to use leisure time better." Among the reasons for acquiring life skills among fifth- and sixth grade elementary school students in Okinawa Prefecture, "to be praised and recognized" scored high in all categories of interest (i.e., diet, living environment, and clothing) [29]. The importance of praise from others in improving the social life skills of children with typical development is also true for children with ASD and ADHD.

However, the activities of the Marine Program are fraught with danger. Therefore, the staff frequently gives encouragement to the participants during the activities. This process is an exchange of passion between the participants and the staff. The 8-word himself sub-net suggests the role of sublimating the accumulated frustrations of the participants," whereas the 7-word participate sub-net represents the social life skills that the parents received from their children. Furthermore, in the "13-word himself sub-net,"" himself is connected to activity," which, in turn, is connected to marine and marine program through observation. These findings suggest that the participants indeed pay attention to their surroundings. During the interviews, the parents said the following:

- My child gets sand on the bottom of his feet when he walks on the beach, which stimulates his sense of touch and broadens his play."
- Looking out over the ocean increases his desire to participate in marine activities.
- Participating in the Marine Program has helped him learn what he can do and what is dangerous.
- My child is now able to communicate with the staff by asking them what he wants to do.
- Now that he can really do what he wants to do, he can empathize with others.

These assumptions may be due to the location of the Marine Program, which is the nature-rich coast of Okinawa. Approaching the lush shores is an exhilarating experience that is free from stress. Its amity functions are considered to be mainly the scent of the rocky shore, the rhythm of the waves, and the stimulation of the skin and mucous membranes by the cool breeze and aerosols [30]. The ocean in Okinawa can accept children with sensory sensitivities. The unique feature of the Marine Program is that it is a combination of individual and group activities, which are play based," on the coast of Okinawa. The OTR divided the content of the Marine Program into spontaneous play, non-competitive games, and competitive games and implemented them in stages [31]. In other words, environmental and individual factors were considered in the activities that lead to participation. These findings suggested that occupational therapy using the Marine Program can improve self-efficacy and social life skills among children with NDDs.

Conclusion

We examined the effectiveness of a regular Marine Program for children with NDDs and focused on the perceptions of their parents. The aspect that parents perceived was the most improved within the Marine Program was the physical aspect." followed by communication and behavioral aspects. Co-occurrence networks from text mining were inferred to represent the role of the participants in sublimating accumulated frustrations and social life skills. These findings suggested that the Marine Program enhanced their self-efficacy and social life skills of participants.

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